IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	St. Lawrence, et al.	)	
		)	Group Art Unit: 2826
Serial No.:	10/613,924	)	
		)	
Filed:	July 3, 2003	)	Examiner: Fazli Erdem
		)	
For:	CIRCUIT MATERIALS, CIRCUITS, MULTI-LAYER CIRCUITS, AND METHODS OF MANUFACTURE THEREOF	)	

Assistant Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT

Sir:

This amendment is submitted in response to the Office Action dated August 1, 2006.

AMENDMENTS TO THE CLAIMS

1. (Previously Presented) A circuit material for the formation of circuits or multi-layer circuits, the circuit material comprising:

a first conductive layer; and

a dielectric layer disposed on the first conductive layer, wherein the dielectric layer comprises a crosslinkable liquid crystalline polymer comprising phenyl maleimide groups, nadimide groups, phenylacetylene groups, or a combination comprising at least one of the foregoing groups; and further comprises a particulate filler, a fibrous web, or a combination comprising at least one of the foregoing, wherein the dielectric layer has a dielectric constant of less than about 3.8, a dissipation factor of less than or equal to about 0.007 when measured from 1 to 10 GHz, and a UL-94 rating of V-1 or better, when the liquid crystalline polymer composition is fully crosslinked.

2. (Original) The circuit material of claim 1, wherein the conductive layer is copper.

3. (Original) The circuit material of claim 1, wherein the dielectric layer is substantially nonflowable when fully crosslinked.

4. (Canceled)

5. (Previously Presented) The circuit material of claim 1, wherein the dielectric layer is flowable when partially crosslinked.

6. (Original) The circuit material of claim 1, further comprising a second conductive layer disposed on the dielectric layer on a side opposite the first conductive layer.

7. (Canceled)

8. (Original) The circuit material of claim 1, wherein the crosslinkable liquid crystalline polymer comprises phenyl maleimide groups.

9. (Canceled)

10. (Previously Presented) A circuit laminate for the formation of circuits or multi-layer circuits, the circuit laminate comprising:

a first conductive layer; and

a dielectric substrate disposed on the first conductive layer, wherein the dielectric substrate comprises a B-staged or thermoset liquid crystalline polymer having crosslinked groups derived from phenyl maleimide groups, nadimide groups, phenylacetylene groups, or a combination comprising at least one of the foregoing groups; and further comprises a particulate filler, a fibrous web, or a combination comprising at least one of the foregoing, wherein the dielectric substrate has a dielectric constant of less than about 3.8, a dissipation factor of less than or equal to about 0.007 when measured at 1 to 10 GHz, and a UL-94 rating of V-1 or better when fully crosslinked.

11. (Original) The circuit laminate of claim 10, wherein the conductive layer is copper.

12. (Canceled)

13. (Canceled)

14. (Currently Amended) A method of forming a circuit material, comprising

contacting a crosslinkable liquid crystalline polymer composition with a conductive layer, wherein the crosslinkable liquid crystalline polymer composition comprises a crosslinkable liquid crystalline polymer comprising phenyl maleimide groups, nadimide groups, phenylacetylene groups, or a combination comprising at least one of the foregoing groups; and further comprises a particulate filler, a fibrous web, or a combination comprising at least one of the foregoing; and

crosslinking the crosslinkable liquid crystalline polymer to form a B-staged or thermoset liquid crystalline polymer dielectric material, wherein the fully crosslinked composition has a dielectric constant of less than about 3.8, a dissipation factor of less than or equal to about 0.007 when measured from 1 to 10 GHz, and a UL-94 rating of V-1 or better.[[.]]

15. (Currently Amended) A circuit comprising:

a dielectric substrate comprising a thermoset liquid crystalline polymer having crosslinked phenyl maleimide groups, nadimide groups, phenylacetylene groups, or a combination comprising at least one of the foregoing groups; and further comprising a particulate filler, a fibrous web, or a combination comprising at least one of the foregoing; and

a first conductive circuit layer disposed on the dielectric substrate, wherein the dielectric substrate has a dielectric constant of less than about 3.8, a dissipation factor of less than or equal to about 0.007 when measured from 1 to 10 GHz, and a UL-94 rating of V-1 or better.[[.]]

16. (Original) The circuit of claim 15, wherein the conductive layer is copper.

17. (Canceled)

18. (Canceled)

19. (Currently Amended) A multi-layer circuit comprising:

a resin coated conductive layer comprising a first conductive layer disposed on a flowable dielectric material; and

a diclad circuit, comprising a dielectric substrate disposed between a circuit layer and a second conductive layer, wherein the flowable dielectric material is disposed on a side of the circuit layer opposite the dielectric substrate, and further wherein

the flowable dielectric material, the dielectric substrate, or both, comprises a thermoset liquid crystalline polymer having crosslinked phenyl maleimide groups, nadimide groups, phenylacetylene groups, or a combination comprising at least one of the foregoing groups;

wherein the multi-layer circuit has a dielectric constant of less than about 3.8, a dissipation factor of less than or equal to about 0.007, and a UL-94 rating of V-1 or better.

20. (Previously Presented) The multi-layer circuit of claim 19, wherein the first conductive layer, second conductive layer, and circuit layer are copper.

21. (Canceled)

22. (Original) The multilayer circuit of claim 19, wherein the dielectric substrate further comprises a particulate filler, a fibrous web, or a combination comprising at least one of the foregoing.

23. (Currently Amended) A multi-layer circuit comprising:

a first diclad circuit comprising a first dielectric substrate disposed between a first circuit layer and a second circuit layer;

a second diclad circuit comprising a second dielectric substrate disposed between a third circuit layer and a fourth circuit layer; and

a bond ply disposed between the second circuit layer on a side opposite the first dielectric substrate layer, and the third circuit layer on a side opposite the second dielectric layer, wherein at least one of the first dielectric substrate, the second dielectric substrate, or the bond ply comprises a B-staged or thermoset liquid crystalline polymer having crosslinked phenyl maleimide groups, nadimide groups, phenylacetylene groups, or a combination comprising at least one of the foregoing groups;

wherein the multi-layer circuit has a dielectric constant of less than about 3.8, a dissipation factor of less than or equal to about 0.007, and a UL-94 rating of V-1 or better.

24. (Canceled)

25. (Original) The multilayer circuit of claim 23, wherein at least one of the first dielectric substrate, the second dielectric substrate, or the bond ply further comprises a particulate filler, a fibrous web, or a combination comprising at least one of the foregoing.

26. (Original) The multilayer circuit of claim 23, further comprising a cover film disposed on the first circuit layer on a side opposite the first dielectric layer, wherein the cover film comprises a thermoset liquid crystalline polymer formed by the crosslinking of phenyl maleimide groups, nadimide groups, phenylacetylene groups, or a combination comprising at least one of the foregoing groups.

27. (Currently Amended) A B-staged circuit material for the formation of circuits or multi-layer circuits, the circuit material comprising:

a first conductive layer; and

a dielectric layer disposed on the first conductive layer, wherein the dielectric layer comprises a liquid crystalline polymer comprising phenyl maleimide groups, nadimide groups, phenylacetylene groups, or a combination comprising at least one of the foregoing groups, wherein the groups have been partially crosslinked; and further comprises a particulate filler, a fibrous web, or a combination comprising at least one of the foregoing; and further wherein the fully crosslinked liquid crystalline polymer has a dielectric constant of less than about 3.8, a dissipation factor of less than or equal to about 0.007 when measured from 1 to 10 GHz, and a UL-94 rating of V-1 or better.[[.]]

28. (Original) The B-staged circuit material of claim 27, wherein the conductive layer is copper.

29. (Currently Amended) A circuit material for the formation of circuits or multi-layer circuits, the circuit material comprising:

a first conductive layer; and

a dielectric layer disposed on the first conductive layer, wherein the dielectric layer comprises a liquid crystalline polymer comprising phenyl maleimide groups, nadimide groups, phenylacetylene groups, or a combination comprising at least one of the foregoing groups, and further wherein said groups crosslink at a temperature that is at least about 20°C greater than the melt temperature of the liquid crystalline polymer.

30. (Previously Presented) The circuit material of claim 29, wherein the conductive layer is copper.

31. (Previously Presented) The circuit material of claim 29, wherein the dielectric layer is substantially nonflowable when fully crosslinked.

32. (Previously Presented) The circuit material of claim 29, wherein the dielectric layer is flowable when partially crosslinked.

33. (Previously Presented) The circuit material of claim 29, further comprising a second conductive layer disposed on the dielectric layer on a side opposite the first conductive layer.

34. (Previously Presented) The circuit material of claim 29, wherein the dielectric layer further comprises a particulate filler, a fibrous web, or a combination comprising at least one of the foregoing.

35. (Previously Presented) The circuit material of claim 29, wherein the liquid crystalline polymer comprises phenyl maleimide groups.

36. (Previously Presented) The circuit material of claim 29, having a dielectric constant of less than about 3.8, a dissipation factor of less than or equal to about 0.007 when measured from 1 to 10 GHz, and a UL-94 rating of V-1 or better, when the liquid crystalline polymer composition is fully crosslinked.

37. (Previously Presented) The circuit laminate of claim 10, further comprising a second conductive layer disposed on the dielectric substrate on a side opposite the first conductive layer.

38. (Previously Presented) The circuit laminate of claim 10, wherein the B-staged or thermoset liquid crystalline polymer comprises crosslinked groups derived from phenyl maleimide groups.

39. (Previously Presented) The method of claim 14, wherein the conductive layer is copper.

40. (Previously Presented) The method of claim 14, wherein the crosslinkable liquid crystalline polymer is substantially nonflowable when fully crosslinked.

41. (Previously Presented) The method of claim 14, wherein the crosslinkable liquid crystalline polymer is flowable when partially crosslinked.

42. (Previously Presented) The method of claim 14, further comprising contacting the crosslinkable liquid crystalline polymer composition with a second conductive layer on a side opposite the first conductive layer and crosslinking the crosslinkable liquid crystalline polymer to form a B-staged or thermoset liquid crystalline polymer dielectric material.

43. (Previously Presented) The method of claim 14, wherein the crosslinkable liquid crystalline polymer comprises phenyl maleimide groups.

44. (Canceled)

45. (Previously Presented) The circuit of claim 15, further comprising a second conductive layer disposed on the dielectric substrate on a side opposite the first conductive layer.

46. (Previously Presented) The circuit of claim 15, wherein the thermoset liquid crystalline polymer comprises crosslinked phenyl maleimide groups.

47. (Previously Presented) The multi-layer circuit of claim 15, wherein the thermoset liquid crystalline polymer comprises crosslinked phenyl maleimide groups.

48. (Previously Presented) The multi-layer circuit of claim 23, wherein the first circuit layer, the second circuit layer, the third circuit layer, and the fourth circuit layer are copper.

49. (Previously Presented) The multi-layer circuit of claim 23, wherein the B-staged or thermoset liquid crystalline polymer comprises crosslinked phenyl maleimide groups.

50. (Previously Presented) The B-staged circuit material of claim 27, wherein the dielectric layer is substantially nonflowable when fully crosslinked.

51. (Previously Presented) The B-staged circuit material of claim 27, wherein the dielectric layer is flowable when partially crosslinked.

52. (Previously Presented) The B-staged circuit material of claim 27, further comprising a second conductive layer disposed on the dielectric layer on a side opposite the first conductive layer.

53. (Previously Presented) The B-staged circuit material of claim 27, wherein the liquid crystalline polymer comprises phenyl maleimide groups.

54. (Canceled)

55. (Previously Presented) A circuit material comprising:

a first conductive layer; and

a dielectric layer disposed on the first conductive layer, wherein the dielectric layer comprises a crosslinkable liquid crystalline polymer comprising phenyl maleimide groups, nadimide groups, phenylacetylene groups, or a combination comprising at least one of the foregoing groups, wherein the circuit material has a dielectric constant of less than about 3.8, a dissipation factor of less than or equal to about 0.007 when measured from 1 to 10 GHz, and a UL-94 rating of V-1 or better, when the liquid crystalline polymer composition is fully crosslinked.

56. (Previously Presented) The circuit material of claim 55, wherein the conductive layer is copper.

57. (Previously Presented) The circuit material of claim 55, wherein the dielectric layer is substantially nonflowable when fully crosslinked.

58. (Previously Presented) The circuit material of claim 55, wherein the dielectric layer is flowable when partially crosslinked.

59. (Previously Presented) The circuit material of claim 55, further comprising a second conductive layer disposed on the dielectric layer on a side opposite the first conductive layer.

60. (Previously Presented) The circuit material of claim 55, wherein the crosslinkable liquid crystalline polymer comprises phenyl maleimide groups.

61. (Previously Presented) A circuit laminate comprising:

a first conductive layer; and

a dielectric substrate disposed on the first conductive layer, wherein the dielectric substrate comprises a B-staged or thermoset liquid crystalline polymer having crosslinked groups derived from phenyl maleimide groups, nadimide groups, phenylacetylene groups, or a combination comprising at least one of the foregoing groups, wherein the circuit laminate has a dielectric constant of less than about 3.8, a dissipation factor of less than or equal to about 0.007 when measured at 1 to 10 GHz, and a UL-94 rating of V-1 or better when fully crosslinked.

62. (Previously Presented) The circuit laminate of claim 61, wherein the conductive layer is copper.

63. (Previously Presented) The circuit laminate of claim 61, further comprising a second conductive layer disposed on the dielectric substrate on a side opposite the first conductive layer.

64. (Previously Presented) The circuit laminate of claim 61, wherein the thermoset liquid crystalline polymer comprises crosslinked groups derived from phenyl maleimide groups.

65. (Previously Presented) A circuit comprising:

a dielectric substrate comprising a thermoset liquid crystalline polymer having crosslinked phenyl maleimide groups, nadimide groups, phenylacetylene groups, or a combination comprising at least one of the foregoing groups; and

a first conductive circuit layer disposed on the dielectric substrate;

wherein the circuit has a dielectric constant of less than about 3.8, a dissipation factor of less than or equal to about 0.007 when measured from 1 to 10 GHz, and a UL-94 rating of V-1 or better.

66. (Previously Presented) The circuit of claim 65, wherein the conductive layer is copper.

67. (Previously Presented) The circuit of claim 65, further comprising a second conductive circuit layer disposed on the dielectric substrate on a side opposite the first conductive circuit layer.

68. (Previously Presented) The circuit of claim 65, wherein the thermoset liquid crystalline polymer comprises crosslinked phenyl maleimide groups.

REMARKS

Claims 1-3, 5, 6, 8, 10, 11, 14-16, 19-43, 45-53 and 55-68 are pending in the present Application. Claims 21 and 24 have been canceled without prejudice. Claims 14, 15, 19, 23, 27, and 29 have been amended, leaving Claims 1-3, 5, 6, 8, 10, 11, 14-16, 19-20, 22, 23, 25-43, 45-53 and 55-68 for consideration upon entry of the present Amendment.

Entry of this amendment is respectfully requested, as it places the application in condition for allowance.

Claims 14, 15, and 27

Claims 14, 15, and 27 have been amended to remove the second period at the end of the claim.

Allowable Claims

Applicants thank the Examiner for the indication of allowability for Claims 1-3, 5, 6, 8, 10, 11, 14-16, 27, 28, 37-43, 45-47 and 55-68.

Claims 50-53

Claims 50-53 presently stand rejected under 35 U.S.C. § 103(a). Applicants respectfully note that Claims 50-53 are dependent from and further limit allowable independent Claim 27. Applicants therefore request allowance of claims 50-53.

Claim Objections

Claims 21 and 24 stand objected to as being dependent upon a rejected base claim, but would be allowable if rewritten independent form, including all of the limitations of the base claims (Claims 19 and 23, respectively) and any intervening claims (none). The limitations of Claims 21 and 24 have accordingly been incorporated into independent Claims 19 and 23, respectively, and Claims 21 and 24 canceled without prejudice.

It is believed that Claim 19 (and its dependent claims, Claims 20 and 22) and Claim 23 (and its dependent claims, 25, 26, 48, and 49) are therefore now allowable.

Claims 29-36 stand objected to because of the last part of Claim 29, which recites "said groups crosslink at a temperature is at least about 20°C greater than the melt temperature of the liquid crystalline polymer". Claim 29 has been amended to add "that" in front of "is" as suggested by the Examiner. Claims 30-36 depend from and further limit Claim 29. Applicants therefore respectfully request the withdrawal of the objection to Claims 29-36.

Claim Rejections Under 35 U.S.C. § 103(a)

Claims 19, 20, 22, 23, 25, 26, and 48-53 stand rejected under 35 U.S.C. § 103(a).

It is believed that the above amendments render these rejections moot.

It is believed that the foregoing remarks fully comply with the Office Action and that the claims herein should now be allowable to Applicants. Accordingly, reconsideration and allowance are requested.

If there are any additional charges with respect to this Response or otherwise, please charge them to Deposit Account No. 06-1130.

Respectfully submitted,

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